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TECHNICAL REPORT
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**STORAGE STABILITY OF BEEF FLAVORED
DEHYDRATED NOODLE VEGETABLE SOUP**

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acceptability began to go down regardless of packaged atmosphere or moisture content.

The results of chemical analyses of soup mixes showed that the peroxide value of dry soup mixes formulated with ring-shaped noodles increased at a faster rate than its counterpart formulated with fine noodles at both temperatures (70°F and 100°F). The oxygen uptake of canned dry soup mix showed that the initial residual oxygen levels decreased to zero or one percent range for all soup mixes at the 9 months storage at 37.8°C (100°F), regardless of packaging atmosphere. At 21°C (70°F), this change was less drastic. Concurrently, CO₂ level increased in all mixes.

It was concluded that dry soup mixes with noodles and vegetables with a moisture range of 4.5 to 5.5 percent can be packaged in air for a period of 6 months at 37.8°C (100°F) or 12 months at 21°C (70°F) without adverse effect on their overall quality.

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PREFACE

This study was conducted to determine the stability of dehydrated beef flavored soup containing noodles and vegetables. Variables studied were the effect of air or nitrogen on packaged soup ingredients which contained either ring-shaped noodles or straight fine noodles.

This effort was undertaken under Project Number 1G464713D548, Military Subsistence Technology.

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STORAGE STABILITY OF BEEF FLAVORED DEHYDRATED NOODLE VEGETABLE SOUP

INTRODUCTION

This study was conducted to determine the effect of oxygen and moisture on the stability of packaged ingredients such as dehydrated beef flavored noodles and vegetables. The dehydrated vegetables are components of dry soup mixes and make up 7.5 percent of the soup formula, whereas noodles make up 51 percent. The remainder is made up of hydrolyzed vegetable protein, sugar, shortening, salt, seasonings and fillers. Dehydrated vegetables are a mixture of 5 ingredients composed of dehydrated chopped onions, diced cabbage, cross-cut celery, cross-cut green beans and red and green pepper mixtures. The moisture content of the dehydrated vegetables was analyzed to be 4 percent. The moisture content of the ring noodles was 6 percent.

Dehydrated soup mixes were formulated with straight noodles as compared with ring-shaped noodles. The ring noodles are slightly higher in moisture content than fine noodles. It was thought that ring noodles could transfer more moisture to the other components and affect the stability of the product. Products were stored both at 21°C (70°F) and 37.8°C (100°F). They were withdrawn at 3, 6 and 9 months from 100°F storage and 6 and 12 months from the 70°F storage. The gases in the packages were either air or nitrogen.

EXPERIMENTAL PROCEDURES

Two sets of samples of dried soup mixes were produced and packed commercially following MIL-S-43931.¹ One set of samples was formulated according to MIL-S-43931 using fine noodles. Another set of samples was packed as above, except that the ring-shaped noodles (higher moisture) were used in place of fine noodles. These mixes were packaged in 401 x 411 cans and sealed in an atmosphere of either air or nitrogen at atmosphere pressure. After 3, 6 and 9 months storage at 37.8°C (100°F) and 6 and 12 months at 21°C (70°F), the composition of the headspace gas, the moisture content of dry soup mix, percent free fatty acid content, peroxide value and sensory characteristics of the reconstituted soup mixes were determined.

¹Military Specification MIL-S-43931, Soup, Dehydrated, Beef Flavored with Noodles and Vegetables, Sep 30, 1975.

Headspace gas analysis

Headspace gases were analyzed by means of a Fisher Partitioner gas chromatograph.² Nitrogen-packaged samples were back-flushed with nitrogen and equilibrated for 16 hours before analysis.

Chemical analyses

For analytical work, samples were tested for moisture content, percentage-free fatty acid content, and peroxide values. The following methods were employed: (a) percent-free fatty acids were determined on chloroform extracted fat, as percent oleic acid in fat;³ (b) peroxide value, milliequivalents oxygen per kg fat was determined by potassium iodide method;⁴ and (c) moisture was determined by vacuum oven at 21°C 70°F) for 6 hours.⁵

Sensory evaluations

A technological panel of 14 food technologists evaluated samples of reconstituted soup served at approximately 65°C (150°F) on 9-point hedonic scale (1 = extremely poor to 9 = excellent) for odor, flavor, texture, appearance, and overall quality.⁶ In reconstitution of the dry soup mix, 116 grams of soup mix was added to 1½ quarts of boiling water and simmered for 10 minutes.

²S.J. Bishov and A.S. Henick, 1977. A Gas Chromatograph Method for Continuous Accelerated Study of O₂ Uptake in Fats. Journal of American Oil Chemist Society, 43:477.

³Official and Tentative Methods of the American Oil Chemists Society, Third Edition, 1977, Method Ca5 A-40.

⁴Official and Tentative Methods of the American Oil Chemists Society, Third Edition, 1977. Method Cd 8-53.

⁵Official Methods of Analysis of the Association of Official Chemists, 12th Edition, 1975, Method 22.013.

⁶G.J. Pilgrim and D.R. Peryam, 1948. "Sensory Testing Methods" A Manual, T.R. 25-48 QMF&CI, Chicago, IL.

RESULTS AND DISCUSSION

Dehydrated soup mixes, regardless of air or nitrogen packing, formulated with ring-shaped noodles or fine noodles, had retained good sensory characteristics when subjected to 37.8°C (100°F) through 6 months (Table 1). However, when 37.8°C (100°F) samples were stored for 9 months, the overall quality and flavor acceptability began to decrease.

a. Peroxide value. Peroxide value of dry soup formulated with ring-shaped noodles increased markedly at 9 months storage at 37.8°C (100°F) as shown in Table 2.

b. Free fatty acid content. Other results of analyses for free fatty acids were inconclusive for these samples.

c. Headspace gas analyses. The oxygen uptake of soup mixes showed that the initial amount of residual oxygen in the headspace of air and nitrogen packed soup mixes varied, but these were narrowed down gradually during storage. At the end of 9 months storage at 37.8°C (100°F), the residual oxygen had decreased to zero for nitrogen-packed and 1 percent for air-packed soup mixes (Table 2). Concurrently, the CO₂ content in the cans, both air- and nitrogen-packed, tended to increase (Table 2).

For a stable shelf-life product in excess of 6 months storage at 37.8°C (100°F), the theoretical moisture content of the product should be lowered to 4 percent maximum; however, this will create a problem in practice. Since it is necessary to double or triple-dry the noodles to reduce the total moisture to less than 4 percent, there are higher energy costs and possible damage to flavor of the noodles.

The stability may be improved by the use of a high Active Oxygen Method (AOM Fat with antioxidants).

CONCLUSION

This study has shown that dry soup mixes with noodles and vegetables with moisture range of 4.5 to 5.5 percent can be packaged in air for a period of up to 6 months at 37.8°C (100°F) and 12 months at 21°C (70°F) without adverse effects on their overall quality. Over 9 months at 37.8°C (100°F), the overall quality and flavor acceptability begins to decrease.

REFERENCES

1. Military Specification MIL-S-43931, Soup, Dehydrated, Beef Flavored with Noodles and Vegetables, Sep 30, 1975.
2. Bishov, S.J. and A.S. Henick, 1977. A Gas Chromatograph Method for Continuous Accelerated Study of O_2 Uptake in Fats. Journal of American Oil Chemist Society, 43:477.
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5. Official Methods of Analysis of the Association of Official Chemists, 12th Edition, 1975, Method 22.013.
6. Pilgrim, G.J. and D.R. Peryam, 1948. "Sensory Testing Methods" A Manual, T.R. 25-48 QMF&CI, Chicago, IL.

TABLE 1

Sensory Rating of Reconstituted Soup Mixes (a) After Storage Under Air and Nitrogen Atmosphere (b) for 6 & 12 Months @ 21°C (70°F) and 3, 6 and 9 months @ 37.8°C (100°F)

Product	Atmosphere in can (Air = A (Nitrogen=N))	Time in Storage	Tem- perature in Storage	Appear- ance	Odor	Flavor	Texture	Overall (c) Quality
(1) w/ring noodles	(A)	Initial	-	6.7	6.4	6.3	6.6	6.3
(2) w/ring noodles	(N)	Initial	-	6.6	6.5	6.2	6.4	6.2
(3) w/fine noodles	(A)	Initial	-	6.5	6.3	6.1	6.4	6.0
(4) w/fine noodles	(N)	Initial	-	6.2	6.2	5.9	6.6	5.0
	(d)			NS	NS	NS	NS	NS
(1) w/ring noodles	(A)	3 months	37.8°C	6.8	6.2	6.3	6.7	6.3
(2) w/ring noodles	(N)	3 months	37.8°C	6.8	6.3	6.3	6.8	6.8
(3) w/fine noodles	(A)	3 months	37.8°C	6.5	6.0	6.2	6.8	6.1
(4) w/fine noodles	(N)	3 months	37.8°C	6.6	6.1	6.1	6.7	6.2
	(d)			NS	NS	NS	NS	NS
(1) w/ring noodles	(A)	6 months	21°C	6.7	6.4	6.3	6.4	6.2
(2) w/ring noodles	(N)	6 months	21°C	6.5	6.2	5.8	6.3	5.8
(3) w/fine noodles	(A)	6 months	21°C	6.6	6.3	6.3	6.4	6.1
(4) w/fine noodles	(N)	6 months	21°C	6.6	6.5	6.2	6.5	6.2
	(d)			NS	NS	NS	NS	NS
(1) w/ring noodles	(A)	6 months	37.8°C	6.5	6.7	6.0	6.3	6.1
(2) w/ring noodles	(N)	6 months	37.8°C	6.4	6.5	6.0	6.3	6.0
(3) w/fine noodles	(A)	6 months	37.8°C	6.4	6.3	5.9	6.3	5.8
(4) w/fine noodles	(N)	6 months	37.8°C	6.3	6.6	5.8	6.3	5.8
	(d)			NS	NS	NS	NS	NS
(1) w/ring noodles	(A)	9 months	37.8 C	6.3	6.1	5.4	6.3	5.7
(2) w/ring noodles	(N)	9 months	37.8 C	6.1	6.1	5.7	6.3	5.7
(3) w/fine noodles	(A)	9 months	37.8 C	5.9	6.0	5.6	6.3	5.7
(4) w/fine noodles	(N)	9 months	37.8 C	6.3	6.1	5.9	6.3	6.0
	(d)			NS	NS	NS	NS	NS
(1) w/ring noodles	(A)	12 months	21°C	6.5	6.3	6.3	6.5	6.2
(2) w/ring noodles	(N)	12 months	21°C	6.3	6.3	6.3	6.5	6.2
(3) w/fine noodles	(A)	12 months	21°C	6.5	6.3	6.3	6.3	6.3
(4) w/fine noodles	(N)	12 months	21°C	6.5	6.3	6.4	6.5	6.5
	(d)			NS	NS	NS	NS	NS

(a) Commercial Products Packed in No. 2½ cans.

(b) Nitrogen pack (less than 2% residual oxygen).

(c)

Means of 14 evaluations: 5=Fair

6=Below good; Above Fair; 7=Good.

(d) Not significant at 5% level.

TABLE 2

Chemical Analyses and Composition of Headspace Gas of the Canned Soup Mix After Storage for 6 & 12 months @ 210F and 3, 6 & 9 months Storage @ 37.80C (1000P)

Product	Atmosphere in can (Air = A (Nitrogen=N)	Time in Storage	Tempera- ture in Storage	Per- ent Mois- ture	Free Fatty Acid(%)	Per- oxide	CO ₂	O ₂	N ₂	CO
(1) w/ring noodles	(A)	Initial	-	5.5	8.0	0	7.5	12.0	81.5	0
(2) w/ring noodles	(N)	Initial	-	5.4	7.5	0	3.5	3.5	93.0	0
(3) w/fine noodles	(A)	Initial	-	4.9	6.2	0	2.0	19.8	78.2	0
(4) w/fine noodles	(N)	Initial	-	4.9	5.9	0	6.0	6.0	88.0	0
(1) w/ring noodles	(A)	3 months	37.80C	4.4	10.0	13	13.9	8.9	78.6	0
(2) w/ring noodles	(N)	3 months	37.80C	4.6	10.5	13	6.9	0.3	93.1	0
(3) w/fine noodles	(A)	3 months	37.80C	4.5	9.1	13	12.3	7.2	75.5	0.4
(4) w/fine noodles	(N)	3 months	37.80C	4.2	8.4	10	7.2	0.3	91.8	0
(1) w/ring noodles	(A)	6 months	210C	4.4	7.4	17	12.0	6.8	81.2	0
(2) w/ring noodles	(N)	6 months	210C	4.3	7.4	14	5.0	4.6	91.4	0
(3) w/fine noodles	(A)	6 months	210C	4.9	6.8	10	6.0	5.5	89.5	0
(4) w/fine noodles	(N)	6 months	210C	4.2	6.3	5	3.0	0.1	96.9	0
(1) w/ring noodles	(A)	6 months	37.80C	4.8	8.4	19	21.5	1.4	77.2	0
(2) w/ring noodles	(N)	6 months	37.80C	4.5	3.6	7	9.8	0.0	90.2	0
(3) w/fine noodles	(A)	6 months	37.80C	4.4	9.0	11	18.6	3.9	77.0	0
(4) w/fine noodles	(N)	6 months	37.80C	4.6	8.7	9	8.1	0.3	91.6	0
(1) w/ring noodles	(A)	9 months	37.80C	5.2	10.2	21	23.7	1.0	74.6	0.7
(2) w/ring noodles	(N)	9 months	37.80C	5.4	9.8	8	12.7	0.3	87.0	0
(3) w/fine noodles	(A)	9 months	37.80C	5.5	7.7	21	25.7	1.0	72.9	0.5
(4) w/fine noodles	(N)	9 months	37.80C	4.7	7.8	8	12.8	0.0	87.2	0
(1) w/ring noodles	(A)	12 months	210C	5.3	8.7	10	10.0	9.7	80.3	0
(2) w/ring noodles	(N)	12 months	210C	5.5	9.3	8	5.4	2.6	92.0	0
(3) w/fine noodles	(A)	12 months	210C	5.2	7.1	7	6.0	15.3	78.7	0
(4) w/fine noodles	(N)	12 months	210C	4.7	6.9	7	16.0	1.7	82.3	0